Home Based ECG Remote Patient Monitoring System

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Abstract-*In this fast world where technology is advancing rapidly, design and development of a continuous Home based ECG Monitoring System will be of immense help to modern health care. Our System comes under healthcare domain. The mobile phone technology which has gained tremendous popularity which can act as an inter-link between the patient and the doctor. The system of our's proposes the idea of a real time, ECG monitoring system through a GSM module which includes an alert with a notification system to alert the doctor of the patient if there are any abnormalities. The heart Diseases causes many deaths worldwide because of the increase in the population and the rise in health care costs. Advancements in the field of medical electronics and communication can help decrease the healthcare cost. The patient will capture the ECG signal and that signal is send to the doctor by SMS.*

Keywords:ECG ,GSM Module ,Mobile Phone, ECG Sensor, Ethernet Module, Development Boards

I. INTRODUCTION

According to a World Health Organization (WHO) estimate, cardiovascular disease is the faster killer with around twenty million people at a risk of sudden heart failure. Some of these lives can often be saved if good and effective health care and cardiac surgery are provided within the so-called golden hour. Therefore, patients who are at risk require that their cardiac health to be monitored frequently whether they are indoors or outdoors so that in case of emergency treatment can be given. In a wireless and wearable electrocardiogram (ECG) sensor transmitting signals to a diagnostic station at the hospital is introduced. An ECG system has been proposed based on mobile platform which transmits abnormal heartbeats identified in a patient-worn unit .Our Project comes under health care domain . Patients will not have to make as many trips to the doctor anymore, since they can upload the collected data from the sensors to the web Server which will collect the bio-signal data using sensors and then upload to the cloud for keeping a record of the unstructured data. This will reduce the waiting time for the triage at the hospitals and minimize visits and reducing the cost of personnel and administrative operations. This convenience increases the quality of life for the patients as they can enjoy other activities instead of spending time commuting to the hospital/clinic and waiting in long triage queues. The huge volume of data produced from the sensors is in an unstructured format, which is very complex to understand and requires different data storage mechanisms than the typical database management system.

A. Motivation

The ECG Android application presented in this paper focuses on the health care domain . With the advancements in embedded information and communication technologies, we can provide intensified health care support of senior citizens at homes and retirement homes. This technology would be helpful to be providing ECG monitoring facility to senior citizens, athletes, military people and common people. By providing the facility to use these technologies in the home, citizens would be able to live independently for a longer period of time, helping to reduce costs of medical equipment Health care is currently facing the challenge of large amount of data that is unstructured, diverse and growing at an exponential rate. Data is constantly streamed through sensors, monitors and instruments in real time that is faster than the medical personnel can keep up with. The advanced techniques and high capacities of cloud computing, processing of a large amount of data can be performed more efficiently support big data analytic.

B. Problem statement

In the health care domain , patients will not have to make as many trips to the doctor any more, since they can upload the collected data from the sensor to the cloud and also send a SMS to the doctor. ECG .Our system will reduce the waiting time for the triage at the hospitals and minimize visits and reducing the cost of personnel and administrative operations.

Increase in the quality of life for the patients as they can enjoy other activities instead of spending time commuting to the hospital/clinic and waiting in long triage queues.

C. Proposed solution

In addition to medical knowledge, various SSE technologies are involved based health care applications, including micro controller and sensor technologies, signal processing, communication protocols, system and software

design (using well documented design patterns), DBMS, web services, data analysis, and cloud techniques. Such an infrastructure should not only satisfy the basic functional requirements, but also address some key non-functional quality requirements, such as performance, privacy/security, portability, scalability, flexibility, and cost. Using the idea of SMS and cloud techniques, this paper presents a solution to use an ECG sensor connected to ATMega micro-controller which captures bio-signals from the human body and sends it to the mobile device wirelessly using GSM Module. When monitoring the ECG of the patient, the monitored data associated with the ECG waves being displayed on the LCD display and the user has the ability to send the data to the doctor. With the proper hardware components like ATMega micro controller and the sensor, the solution can monitor the ECG of a person in any environment at low costs, without having to purchase any costly ECG monitoring devices.

II. OVERVIEW OF CONCEPTS

Mobile-Based Health care Service:

Mobile devices are evolving at a rapid pace in the deployment of health care services. Our system is mainly based on real-time long-term health monitoring, catering to the demand of assisted living and health fitness information provider. Thus, the deployment of mobile devices into the mobile health care system focuses on several significant features for a medical health care system.

Communication between ECG kit and Mobile Device:

GSM is applied into the system because GSM is responsible for sending the data to on doctors mobile phone. facilities are available in numerous smart devices. The doctor can check the ECG readings from his mobile device.

III. DESIGN AND IMPLEMENTATION

A. System Architecture

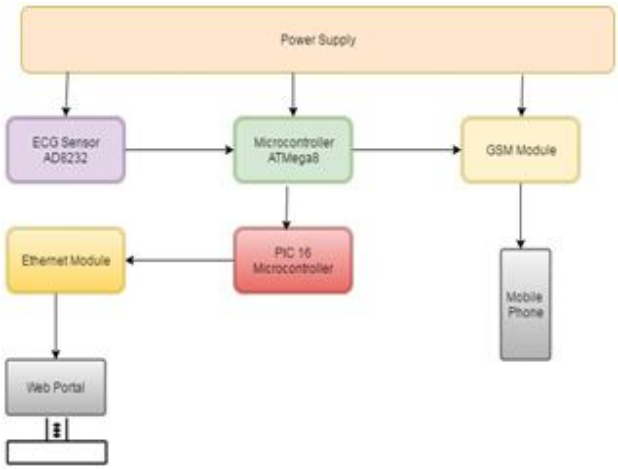


Figure 1. System Architecture

The end-to-end system architecture for this IoT based project involves the hardware, the mobile system and the Web Portal. The application has three sub layers named as follows: Service layer, Platform Application layer and The File Transfer and Writing layer. The hardware layer contains the ATMEGA8 micro controller and ECG sensor, which collects the bio signal data and this data is transmitted by the GSM Module Mobile System as an SMS.

The Application layer contains three sub layers within the layer itself. The Service Layer is the to op layer in the application layer, which interacts with the hardware layer. The ECG Service is present within the Service layer, which is responsible for retrieval of the bio signal data from the hardware layer and storing the data in the buffer within ECG Model, which performs the writing of the data.

B. ECG Sensor:

This sensor is a cost-effective board used to measure the electrical activity of the heart. This electrical activity can be charted as an ECG or Electrocardiogram and output as an analog reading. ECG can be extremely noisy, the AD8232 Single Lead Heart Rate Monitor acts as an op amp to help obtain a clear signal from the PR and QT Intervals easily. The AD8232 is an integrated signal conditioning block for ECG and other bio-potential measurement applications. It is designed to extract, amplify, and filter small bio-potential signals in the presence of noisy conditions, such as those created by motion or remote electrode placement. The AD8232 module breaks out nine connections from the IC that you can solder pins, wires, or other connectors to. SDN, LO+, LO-, OUTPUT, 3.3V, GND provide essential pins for operating this monitor with a Micro controller.

Features:

- Operating Voltage - 3.3V
- Analog Output
- Leads-Off Detection
- Shutdown Pin
- LED Indicator
- 3.5mm Jack for Bio-medical Pad Connection or Use 3 pin header

C. ATMega8 micro-controller:

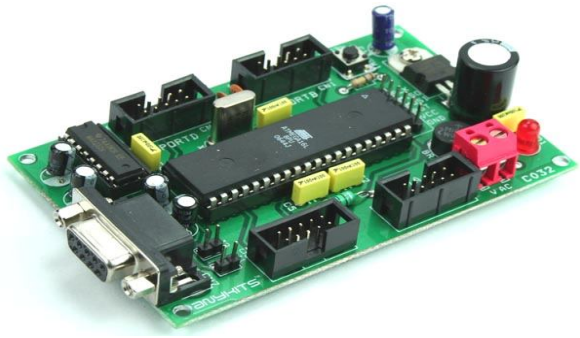


Figure 2 ATMEGA 8 Micro controller

AT mega 8 development board provides a very simple &cost effective platform for beginners, students & researcher. This board contains RESET,RS232 communication, LCD Interfacing. The board can easily programmed using In-System Programmer (ISP),so you can quickly update the program & test it again during development stage.

FEATURES

- High Performance, Low Power AVR 8 bit micro controller
- Operating voltage: 4.5V to 5.5V, Typ. 5V
- All ports are accessible with extended berg connector
- On board Reset Switch
- ISP (In System Programming) Connector
- RS-232 Serial Port
- 2x16 LCD Interfacing Facility
- On Board Regulated 12V, 5V , Variable voltage power supply
- Multiple output termination points for 12V, 5V and variable voltage
- Board Size 101x93mm(3.97”x3.66”)
- 4 Mounting Hole each with 4mm

D. PIC 16 micro-controller:

Figure 3 – PIC 16 Micro-controller

This board is suitable for general & special purpose applications. It has LCD, RS-232 serial port, ADC & I/O pins etc. which you would need to develop any application. Extended port pins allow you to connect any hardware with this board. This board is compatible for PIC 16F & 18F series micro-controller.

FEATURES

- 16 bit micro-controller
- Operating Voltage: -0.3V to +7.5V, Typ. 5V
- Extended ADC pins
- 2x16 LCD interfacing facility
- RS-232 serial port
- RESET button
- 15V-35V/1A, AC/DC input supply facility
- Board Size 101x93mm(3.97”x3.66”)
- 4 Mounting Hole each with 4mm

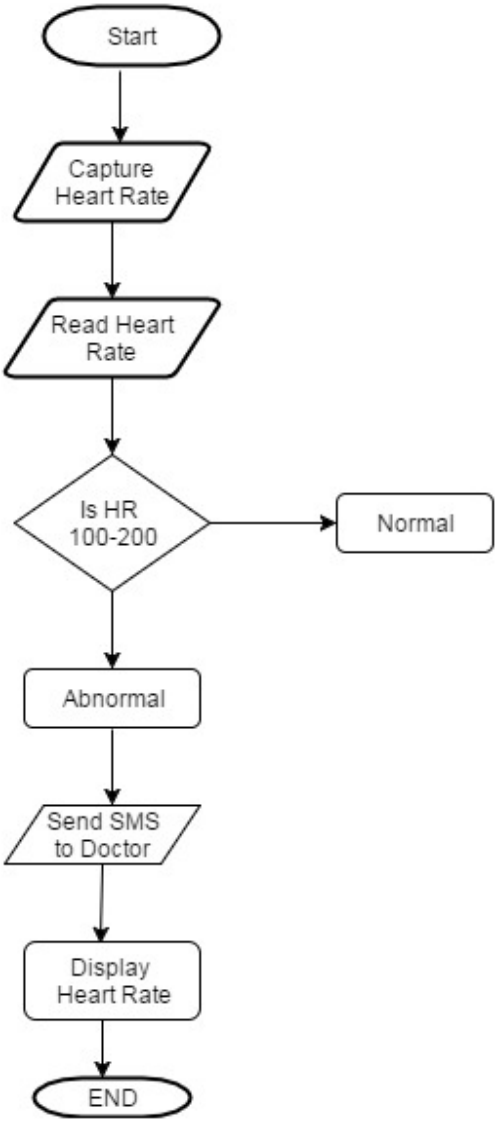
E. GSM Module

GSM/GPRS module is used to establish communication between a computer and a GSM-GPRS system. Global System for Mobile communication (GSM) is an architecture used for mobile communication in most of the countries. Global Packet Radio Service (GPRS) is an extension of GSM that enables higher data transmission rate. GSM/GPRS module consists of a GSM/GPRS modem assembled together with power supply circuit and communication interfaces (like RS-232, USB, etc) for computer.

F. Ethernet Module

There is on-board voltage regulation, so you can use 5-12V VCC input. The signal pins support both 3.3V and 5V levels.The Ethernet Module has a standard RJ-45 connection, with an integrated line transformer. Another similar version exists with "Power Over Ethernet" connections that use the pins marked P+, P-, and G; this one does not use those.

G. Flowchart



F. Algorithm

1. The first step of this procedure is to select patient who is undergoing treatment.
2. User will set start date and time to generate automatic SMS schedule.
3. Once setting date and time, SMS schedule would be created for corresponding patient and store into database.
4. A Boolean field IsSendComplete is included to verify for sent or unsent SMS.
5. After sending an SMS, IsSendComplete filed would be true and updated database as sent SMS.
6. A timer will check next time point of unsent SMS from database to send SMS as notification to patient's mobile phone.
7. This process will continue until end of the time point of SMS schedule.

IV.CONCLUSION

The main objective of this paper was to build an Home based ECG Remote patient monitoring system under health care domain .Our proposed system is able to transmit the patient's heart rate during critical period to the doctor's mobile phone. If doctor is not present at the hospital, he will receive a SMS on his mobile phone in case any of the parameter of the patient goes beyond the normal range. The probes of the ECG must stick properly to the patient, which is nearest to the chest side of patient. So that the correct ECG reading and signal transmission could be obtained. To facilitate immediate response by the doctor to attend to the patient promptly in the case of any emergency situation, the signal strength of the GSM mobile should be very strong.

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